

an insulation layer between the bonding pad layer, the current conduction structure, the mechanical support structure and the substrate for isolating the current conduction structure from the mechanical support structure.

REMARKS

Present Status of the Application

The Office Action mailed July 29, 2002 rejected all presently pending claims 1-15. Specifically, claims 1 and 8 are rejected under 35 U.S.C. 112 as containing subject matters not described in the specification, claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamada (U.S. Pat. 6,297, 523), and claims 8-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamada in view of Lu et al. (U.S. Pat. 6,100,573). Applicant has *amended independent claims 1 and 8* to overcome the rejections under 35 U.S.C. 112.

Summary of Applicant's Invention

The Applicant's invention is directed to a bonding pad structure. The bonding pad structure comprises a bonding pad, and a current conduction structure and a mechanical support structure under the bonding pad. The current conduction structure and the mechanical support structure are located over a device section and a non-device section, respectively, and each structure comprises a plurality of metallic layers and plugs, wherein the upmost metallic layer is electrically connected to the bonding pad.

An example of the bonding pad structure of this invention is shown in the amended FIG. 1, wherein a substrate 100, a bonding pad 116, a current conduction structure 114, a mechanical support structure 112, a device section 118 and a non-device section 120, etc., are illustrated.

Rejections under 35 U.S.C. 112

Regarding the questioned phrase: "...a device section and a non-device section..." in claims 1 and 8, Applicant respectfully points out that the "device section" is mentioned in paragraph [0020], line 16, and the "non-device section" is mentioned in paragraph [0009], line 23.

However, Applicant has also added a reference number of the device section into paragraph [0020], supplemented a description related to the non-device section in paragraph [0021], and labeled the device section and the non-device section in FIG. 1 for amendments. Please refer to the amended paragraphs [0020], [0021] and FIG. 1, the device region 118 and the non-device region 120 are not new matters since they have been disclosed in the text of the specification, and are just missing in the original drawings.

Moreover, Applicant has deleted the phrase: "...a plurality of via plugs for linking up the current conduction structure and mechanical support structure..." from claims 1 and 8.

Rejections under 35 U.S.C. 103

Rejections of Claims 1-7

In Examiner's opinions, Yamada disclosed a bonding pad structure that comprises a substrate, a bonding pad layer 32, an area structure A serving as a current conduction structure of

the bonding pad between the bonding pad and the substrate, and an area structure B serving as a mechanical support structure between the bonding pad and the substrate.

However, Applicant respectfully points out that the reference character of the bonding pad layer should be 32b, not 32, while the layer labeled with "32a" is a wiring layer (col. 9, line 25). The wiring layer 32a and the bonding pad layer 32b are completely different in their functions since the bonding pad layer 32b is for electrical connecting with the outer circumstance, while the wiring layer 32a is a part of the internal circuit. Therefore, Applicant respectfully submits that the wiring layer 32a and the bonding pad layer 32b cannot be called a bonding pad layer 32 together.

Moreover, since the wiring layer 32a is not a part of the bonding pad layer 32b, the **area structure A** under the wiring layer 32a is **not located between the bonding pad layer 32b and the substrate**, and should not be a portion of the bonding pad structure for connecting the bonding pad layer and the substrate. Therefore, the area structure A is not a current conduction structure of the bonding pad structure, while **only the area structure B belongs to the bonding pad structure**. That is, it should be the area structure B only that corresponds to the current conduction structure and the mechanical support structure of this invention.

As mentioned above, one feature of the bonding pad structure of this invention is the current conduction structure over the device section and under the bonding pad, and the mechanical support structure over the non-device section and under the bonding pad (*the statement: "between the bonding pad and the substrate" indicates that the current conduction structure and the mechanical support structure are under the bonding pad*), while the feature is recited in independent claims 1 and 8 with underline marks.

1. (Twice amended) A bonding pad structure, comprising:
a substrate having at least a device section and a non-device section;
a bonding pad layer above the substrate;
a current conduction structure over the device section, between the bonding pad layer and the substrate for connecting the bonding pad layer and the substrate electrically, wherein the current conduction structure includes:
a plurality of conductive metallic layers, wherein each conductive metallic layer is at a different height level from the substrate; and
a plurality of conductive plugs for linking neighboring conductive metallic layers and the conductive metallic layers with the bonding pad layer and the substrate;
a mechanical support structure over the non-device section, between the bonding pad layer and the substrate, wherein the mechanical support structure includes:
a plurality of support metallic layers, wherein each support metallic layer is at a different height level from the substrate; and
a plurality of support plugs for linking up neighboring support metallic layers and the support metallic layers with the bonding pad layer and the substrate; and
an insulation layer between the bonding pad layer, the current conduction structure, the mechanical support structure and the substrate for isolating the current conduction structure from the mechanical support structure.

8. (Twice amended) A bonding pad structure, comprising:
a substrate having at least a device section and a non-device section;
a bonding pad layer above the substrate;
a current conduction structure over the device section, between the bonding pad layer and the substrate for connecting the bonding pad layer and the substrate electrically, wherein the current conduction structure includes:
a plurality of conductive metallic layer, wherein each conductive metallic layer is at a different height level from the substrate and one of the conductive metallic layers is in direct contact with the substrate; and
a plurality of conductive plugs for linking neighboring conductive metallic layers and linking one of the conductive metallic layers with the bonding pad layer;
a mechanical support structure over the non-device section, between the bonding pad layer and the substrate, wherein the mechanical support structure includes:
a plurality of support metallic layers, wherein each support metallic layer is at a different height level from the substrate and one of the support metallic layers is in direct contact with the substrate; and
a plurality of support plugs for linking neighboring support metallic layers and linking one of the support metallic layers with the bonding pad layer; and
an insulation layer between the bonding pad layer, the current conduction structure, the mechanical support structure and the substrate for isolating the current conduction structure from the mechanical support structure.

As shown in FIG. 1 and the related description of Yamada, Applicant respectfully submits that the area structure B does not contain a current conduction structure over a device section and a mechanical support structure over a non-device section since the area directly under the bonding pad layer is not divided into a device section and a non-device section. That is, Yamada fails to teach or suggest a bonding pad structure that includes *a current conduction structure over a device section* and *a mechanical support structure over a non-device section*.

For at least the reasons mentioned above, Applicant respectfully submits that independent claim 1 patently defines over Yamada.

For the same reasons mentioned above, Yamada also fails to teach or suggest the details of the current conduction structure of the bonding pad structure and the mechanical support structure of the bonding pad structure as described in claims 2-4 and 6-7 of this invention. The details include the comparisons of the cross-sectional areas (claim 2), the numbers of the metallic layers (claims 3), the height levels (claim 4) of the two structures, and the distribution of plugs of each structure (claims 6 and 7). Similarly, it is not obvious for one skilled in the art to figure out the two structures that varies in the numbers of the metallic layers as described in claim 5.

For at least the same reasons mentioned above, Applicant respectfully submits that dependent claims 2-7 also patently define over Yamada.

Rejections of Claims 8-15

As mentioned above, claim 8 also discloses a bonding pad structure that includes a current conduction structure over a device section and a mechanical support structure over a non-

device section, while differs from claim 1 in that one of the conductive metallic layers and one of the support metallic layers is in direct contact with the substrate.

On the other hand, as mentioned above, Yamada fails to teach or suggest a bonding pad structure that includes a current conduction structure over a device section and a mechanical support structure over a non-device section. Lu et al. also fails to teach or suggest a bonding pad structure that includes a current conduction structure over a device section and a mechanical support structure over a non-device section since the area directly under the bonding pad layer is not divided into a device section and a non-device section. Therefore, claim 8 cannot be obtained by combining Yamada and Lu et al. even though Lu et al. disclose a plurality of first metallic layers 304 in direct contact with the substrate 300.

For at least the reasons mentioned above, Applicant respectfully submits that independent claim 8 patently defines over the combination of Yamada and Lu et al.

For at least the same reasons mentioned above, Applicant respectfully submits that dependent claims 9-15 also patently define over the combination of Yamada and Lu et al. since they are dependent on claim 8.

CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims 1-15 are in proper condition for allowance. If Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted

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VERSION WITH MARKINGS TO SHOW WHERE CHANGES MADE

In The Drawings

Please replace the original FIG. 1 with the amended one marked with red ink.

In The Specification

Please amend paragraphs [0020] and [0021] as follows:

[0020] The current conduction structure 114 includes a plurality of serially connected metallic layers 104a, 104b, 104c each located at a different height level between the bonding pad layer 116 and the substrate 100. The conductive metallic layers 104a, 104b, 104c are linked together via plugs 110a and 110b, respectively. The conductive metallic layer 104c and the bonding pad layer 116 are linked together via plugs 110c. The conductive metallic layer 104a is in contact with the substrate 100 so that the current conduction structure 114 actually connects the bonding pad layer 116 and the substrate 100 together. The conductive metallic layers 104a, 104b, 104c connect electrically with a signal line (not shown). Hence, the conductive metallic layers are electrically connected to a device section [(not shown)] 118 on the substrate 100. The conductive metallic layers can be local metallic interconnects, for example.

[0021] The mechanical support structure 112 is disposed over a non-device section 120, and includes a plurality of serially connected support metallic layers 102a, 102b and 102c, each located at a different height level between the bonding pad layer 116 and the substrate 100. The support metallic layers 102a, 102b, 102c are linked together via plugs 108a and 108b. The support metallic layer 102c and the bonding pad layer 116 are linked together via plugs 108c. The support metallic layer 102a and the substrate 100 are in contact with each other to form the

mechanical support structure 112 between the bonding pad layer 116 and the substrate 100. The support metallic layers can be local metallic interconnects, for example.

In The Claims

Please amend independent claims 1 and 8 as follows:

1. (Twice amended) A bonding pad structure, comprising:
 - a substrate having at least a device section and a non-device section;
 - a bonding pad layer above the substrate;
 - a current conduction structure over the device section, between the bonding pad layer and the substrate for connecting the bonding pad layer and the substrate electrically, wherein the current conduction structure includes:
 - a plurality of conductive metallic layers, wherein each conductive metallic layer is at a different height level from the substrate; and
 - a plurality of conductive plugs for linking neighboring conductive metallic layers and the conductive metallic layers with the bonding pad layer and the substrate;
 - a mechanical support structure over the non-device section, between the bonding pad layer and the substrate, wherein the mechanical support structure includes:
 - a plurality of support metallic layers, wherein each support metallic layer is at a different height level from the substrate; and
 - a plurality of support plugs for linking up neighboring support metallic layers and the support metallic layers with the bonding pad layer and the substrate;

[a plurality of via plugs for linking up said current conduction structure and said mechanical support structure with said bonding pad layer]; and

an insulation layer between the bonding pad layer, the current conduction structure, the mechanical support structure and the substrate for isolating the current conduction structure from the mechanical support structure.

8. (Twice amended) A bonding pad structure, comprising:

a substrate having at least a device section and a non-device section;

a bonding pad layer above the substrate;

a current conduction structure over the device section, between the bonding pad layer and the substrate for connecting the bonding pad layer and the substrate electrically, wherein the current conduction structure includes:

a plurality of conductive metallic layer, wherein each conductive metallic layer is at a different height level from the substrate and one of the conductive metallic layers is in direct contact with the substrate; and

a plurality of conductive plugs for linking neighboring conductive metallic layers and linking one of the conductive metallic layers with the bonding pad layer;

a mechanical support structure over the non-device section, between the bonding pad layer and the substrate, wherein the mechanical support structure includes:

a plurality of support metallic layers, wherein each support metallic layer is at a different height level from the substrate and one of the support metallic layers is in direct contact with the substrate; and

a plurality of [via] support plugs for linking neighboring support metallic layers and linking one of the support metallic layers with the bonding pad layer;

[a plurality of support plugs for linking up said current conduction structure and said mechanical support structure with said bonding pad layer]; and

an insulation layer between the bonding pad layer, the current conduction structure, the mechanical support structure and the substrate for isolating the current conduction structure from the mechanical support structure.